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REFERENCES: Philco WDL Letter 16-615-2-(149), dated 28 December 1962, subject: Design Criteria for 698 BK/MSAP Interface Equipment.

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Title	No. and Date
Engineering Plan, GDHE/MUSAP Command Interface	WDL-TR2029 26 February 1963

PHILCO CORPORATION
Western Development Laboratories

R. W. Boyd

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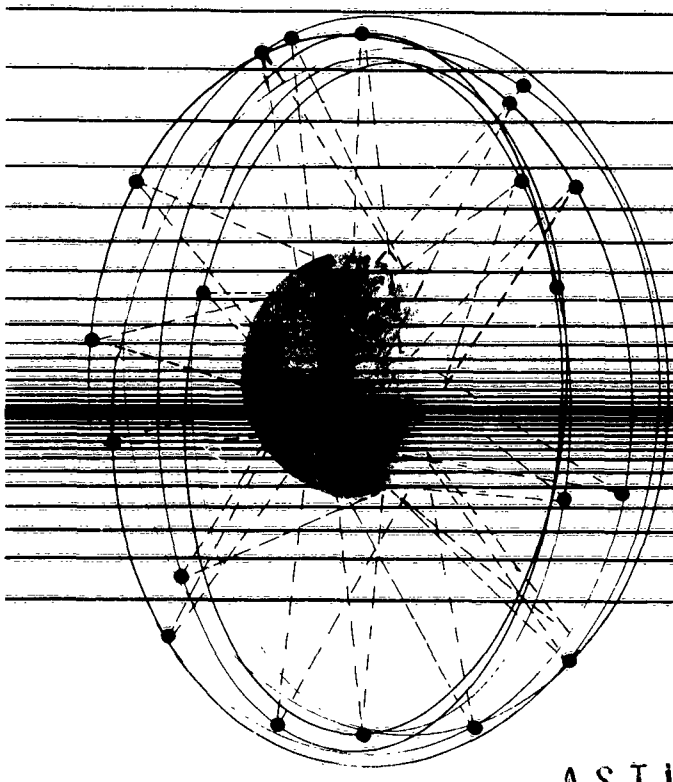
Manager, Contracts Management

WDL-TR2029

26 FEBRUARY 1963



ENGINEERING PLAN
GROUND DATA HANDLING EQUIPMENT/ MUSAP COMMAND INTERFACE

PREPARED FOR:

AIR FORCE SPACE SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
INGLEWOOD, CALIFORNIA

CONTRACT NO. AF04(647)-278

PHILCO
A SUBSIDIARY OF Ford Motor Company

WESTERN DEVELOPMENT LABORATORIES
PALO ALTO, CALIFORNIA

ENGINEERING PLAN
GDHE/MUSAP COMMAND INTERFACE

Prepared by

PHILCO CORPORATION
Western Development Laboratories
Palo Alto, California

Contract No. AF04(647)-278

Prepared for

SPACE SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
Inglewood, California

ABSTRACT

PHILCO WDL-TR2029 UNCLASSIFIED
ENGINEERING PLAN
GDHE/MUSAP COMMAND INTERFACE 12 pages
26 February 1963 Contract AF04(647)-278

This engineering plan describes the equipment and modifications necessary to interface the existing Ground Data Handling Equipment (GDHE) with the Multiple Satellite Augmentation Program (MUSAP) command equipment at NHS and VTS.

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FOREWORD

This Engineering Plan was prepared by Philco Western Development Laboratories in fulfilling the requirements of Philco WDL Letter 16-615-2(149), dated 28 December 1962.

The subject plan is based upon the Design Criteria for 698 BK/MUSAP Interface Equipment, published on 28 December 1962. The design criteria prepared by Philco for the interface equipment is required to connect the 698BK command consoles with the MUSAP/A equipment at NHS and VTS.

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1. GENERAL

This engineering plan describes the equipment and modifications necessary to interface the existing Ground Data Handling Equipment (GDHE) with the Multiple Satellite Augmentation Program (MUSAP) command equipment at NHS and VTS.

2. SUBSYSTEM REQUIREMENTS

2.1 Command Mode

A MUSAP remote analog computer auto command mode of operation shall be established to permit manual, random selection of commands by the GDHE operator from the CDC 160A computer program. Commands originating from the GDHE as relay closures shall require transmission of either one or three real-time analog commands (discrete tone pairs), depending upon the position of matrix relays in the vehicle equipment, as continuously verified by telemetry on a separate channel.

2.2 Number of Commands

The maximum number of commands generated by the GDHE will be 99. Commands from the GDHE to the interface panel will be in the form of relay closures to a common. The relays in the GDHE are of the latching type, and, upon command initiation, remain latched until receipt of command verification from the computer.

2.3 Input Status Signals to GDHE*

The following input status signals are required by the GDHE:

a. Enable (Command Link OK). The "Enable" signal shall be a relay closure to a common.

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* These input signals may share the same common.

b. Loss Warning. The "Loss Warning" signal shall be a relay closure to a common.

c. Command Link Lost. The "Command Link Lost" signal shall be a relay closure to a common, and shall open when the computer receives the next "Command Request."

2.4 Input Status Signals to IOB*

The following input status signals are required by the IOB for display on the SOC:

a. Ready. The "Ready" signal shall be a relay closure to a common.

b. In Progress. The "In Progress" signal shall be a relay closure to a common.

c. Complete. The "Complete" signal shall be a relay closure to a common.

2.5 Command Request

A "Command Request" signal shall be provided to the computer via the CLE and IOB 40 ± 10 milliseconds after GDHE command initiation and GDHE command relay closure. The "Command Request" shall be a relay closure to common of 15 ± 3 milliseconds duration. The "Command Request" shall function as a "Transit" signal to the CLE and the computer to initiate transmission of a selected command.

2.6 Command Verification

The verification of a given command series, as derived from real-time telemetry, shall cause the computer to provide a "Command Block

---

* The above input signals share the same common, and are available from the GDHE.

Verified" to the CLE. A normally closed relay in the CLE shall open for 25 ± 5 milliseconds to provide command verification to the GDHE. This "Command Block Verified" signal shall function to unlatch the command relays in the GDHE.

2.7 Command Link Lost

Upon computer receipt of verification of a discrete tone pair in a given command series, transmission of that tone pair shall cease. After approximately one-half second, the next tone pair in the command series shall be transmitted. Any discrete tone pair shall be transmitted for a maximum of three seconds. After three seconds, if verification is not received via real-time telemetry, the computer shall cause command transmission to cease and a "Command Link Lost" signal to be delivered to the GDHE.

2.8 Loss Warning

Sixty seconds prior to signal fade, a "Loss Warning" signal will be generated by the computer for display at the GDHE. As previously indicated, the "Loss Warning" signal shall be a relay closure to a common. Loss Warning shall be derived from the ETT.

3. DESIGN APPROACH

The design will make maximum use of the CDC 160A computer to provide the timing and logic necessary for the sequencing of the command message by the MUSAP Command Logic Equipment (CLE). Since the required mode of operation is slightly different from that presently provided by the MUSAP command equipment, a minor modification to the CLE will be required. This modification will increase the capability of the command system, possibly benefiting future programs. Status signals between the Input-Output Buffer (IOB) and the GDHE will require four additional relay cards in the IOB. The spare patching facilities of the Station Program Board (SPB) will be used as required to be consistent with the MUSAP signal distribution philosophy.

Because the CLE is designed to operate from BCD inputs, an interface unit must be provided to translate the 99 command selection inputs from the GDHE into BCD suitable for use by the CLE and the computer. This unit will be known as the Command Interface Equipment (CIE).

A block diagram of the proposed configuration is shown in Fig. 1. The operational performance is described in Para. 4 (below).

4. FUNCTIONAL PERFORMANCE

When the command link has been established and the "Remote Command Ready" signal has been received from the GDHE, the SOC operator actuates the "Remote Enable" switch. The Station Program Board for this type of vehicle will be wired to select the "Computer Auto Mode" automatically when the "Remote Enable" is received by the CLE and IOB. This causes the computer to send the "Command Link OK" signal to the GDHE. The GDHE operator may then transmit a command by depressing one of the 99 command pushbuttons.

The "Command Select" switch closure is converted into Binary Coded Decimal (2 digits) by the CIE, and is provided as a "Command Block Number" to the IOB via the CLE. Forty milliseconds later, the GDHE automatically sends the "Transmit" ("Command Request", Para. 2.5) signal to the CLE, causing the computer to select from the program the first command from the indicated command block, and to provide it to the CLE as a BCD command number for one of the 15 available commands. The determination of whether the command block shall consist of one or three commands is made by the computer after checking the address verification signals provided continuously to the IOB ("Command Mode", Para. 2.1).

The CLE will transmit this command continuously until the command number is withdrawn by the computer (receipt of verification or loss of command link, Para. 2.7). The computer continues in this manner, unless halted by loss of command link, until all commands in the command

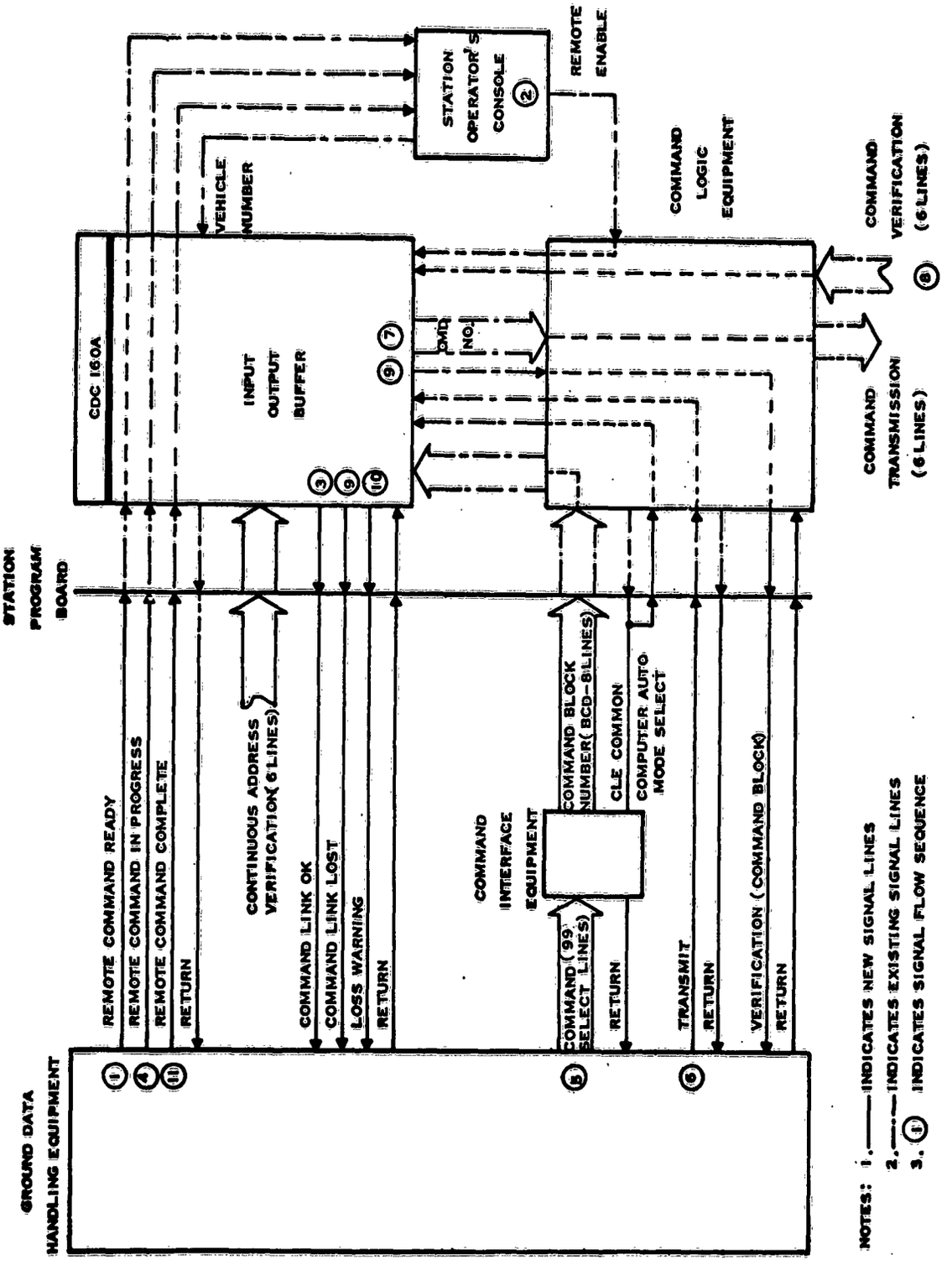


Fig. 1 A Block Diagram of the Proposed Command Interface

block have been verified, at which time it causes the CLE to provide the "Command Block Verified" signal (Para. 2.6) to the GDHE. The GDHE operator may continue to command until the "Loss Warning" signal is received from the IOB (Para. 2.8). At this time, or sooner if appropriate, the operator transmits the "Remote Command Complete" signal to the SOC via the IOB.

5. NEW EQUIPMENT

The CIE is the only major equipment item which must be provided. It will be housed in a single standard Philco data cabinet located in the GDHE area (see Fig. 2). The cabinet will contain approximately 60 logic cards mounted in a four-file drawer. The two required power supplies will be mounted on the rear of the drawer. Standard Philco logic cards and packaging techniques will be utilized throughout.

6. MODIFICATIONS TO EXISTING EQUIPMENT

Existing spare capability will be utilized in the SPB, IOB, and CLE. In addition, the CLE and computer program must be modified so that Computer Auto Mode will accomodate the operation described in Para. 4. This modification will require approximately four additional logic cards and minor rewiring of the CLE. As a result of this modification, the CLE will increase its flexibility, since the computer will have additional control over the CLE operation. The IOB will require four additional relay output cards.

7. INSTALLATION AND CHECKOUT

The CIE will be located in the GDHE area at both NHS and VTS. Phase III and IV test procedures will be prepared by Philco, who will have installation responsibility at both sites. Philco field engineers will be provided to assist the I&C effort.

8. SPECIFICATION PLAN

The subsystem requirements will be documented by an amendment to the MUSAP Data Subsystem Specification. A procurement specification and acceptance test specification will be required for the CIE, and

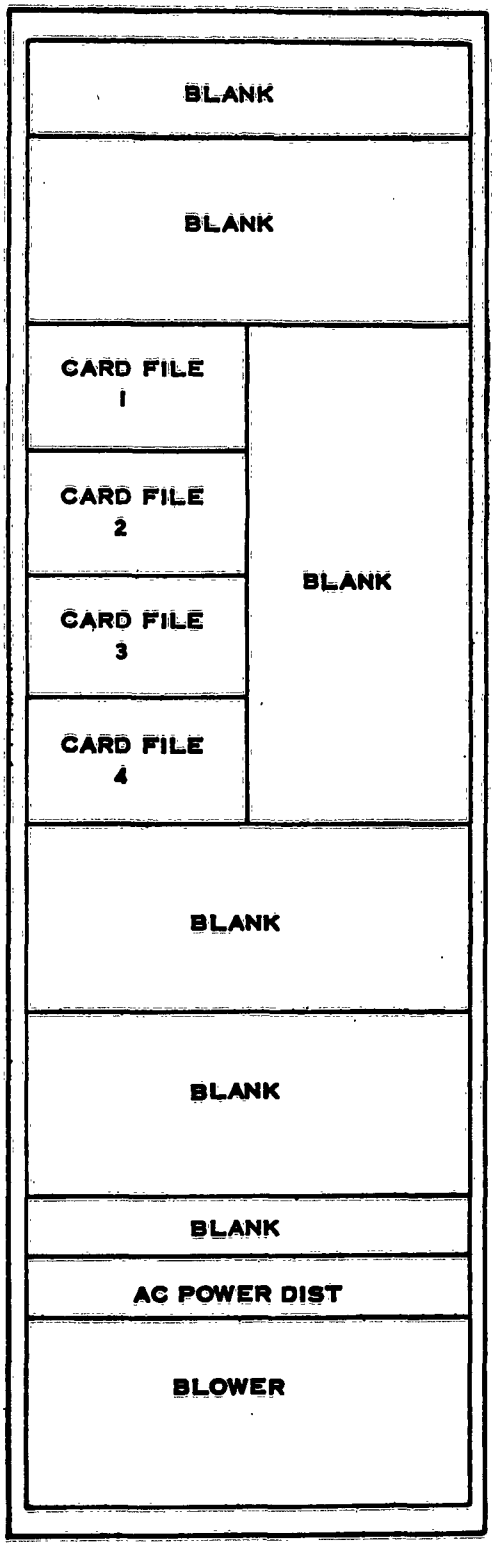
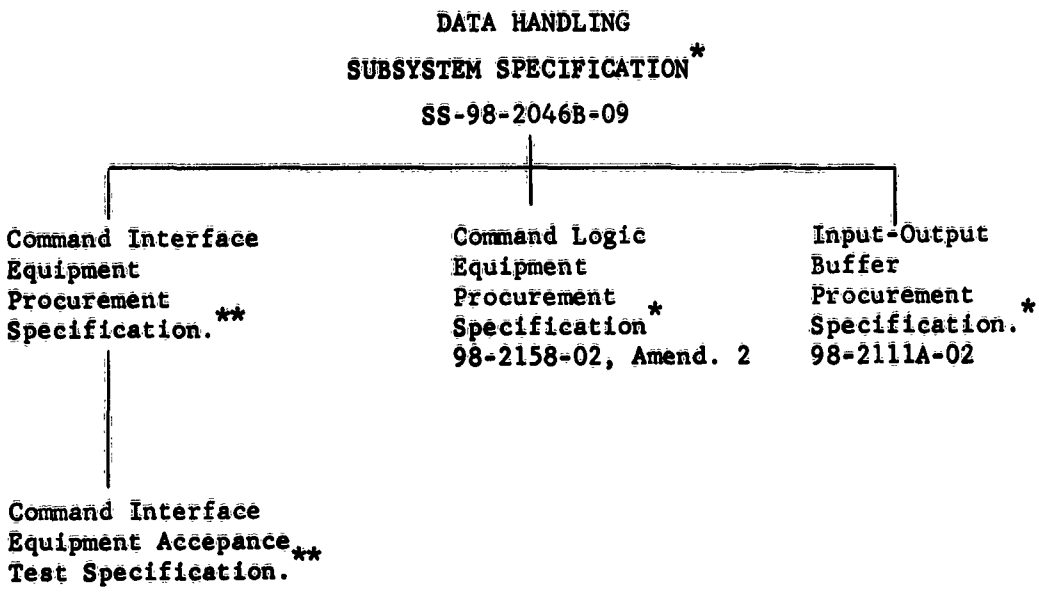


Fig. 2 Command Interface Equipment

the modification and additions to the CLE, SPB, and IOB will be documented by amendments to their respective specifications. The specification is shown in Fig. 3.

9. SCHEDULE

A planning schedule is shown in Fig. 4.



* Amendment Required

** New Specification Required

Fig. 3 Specification Tree

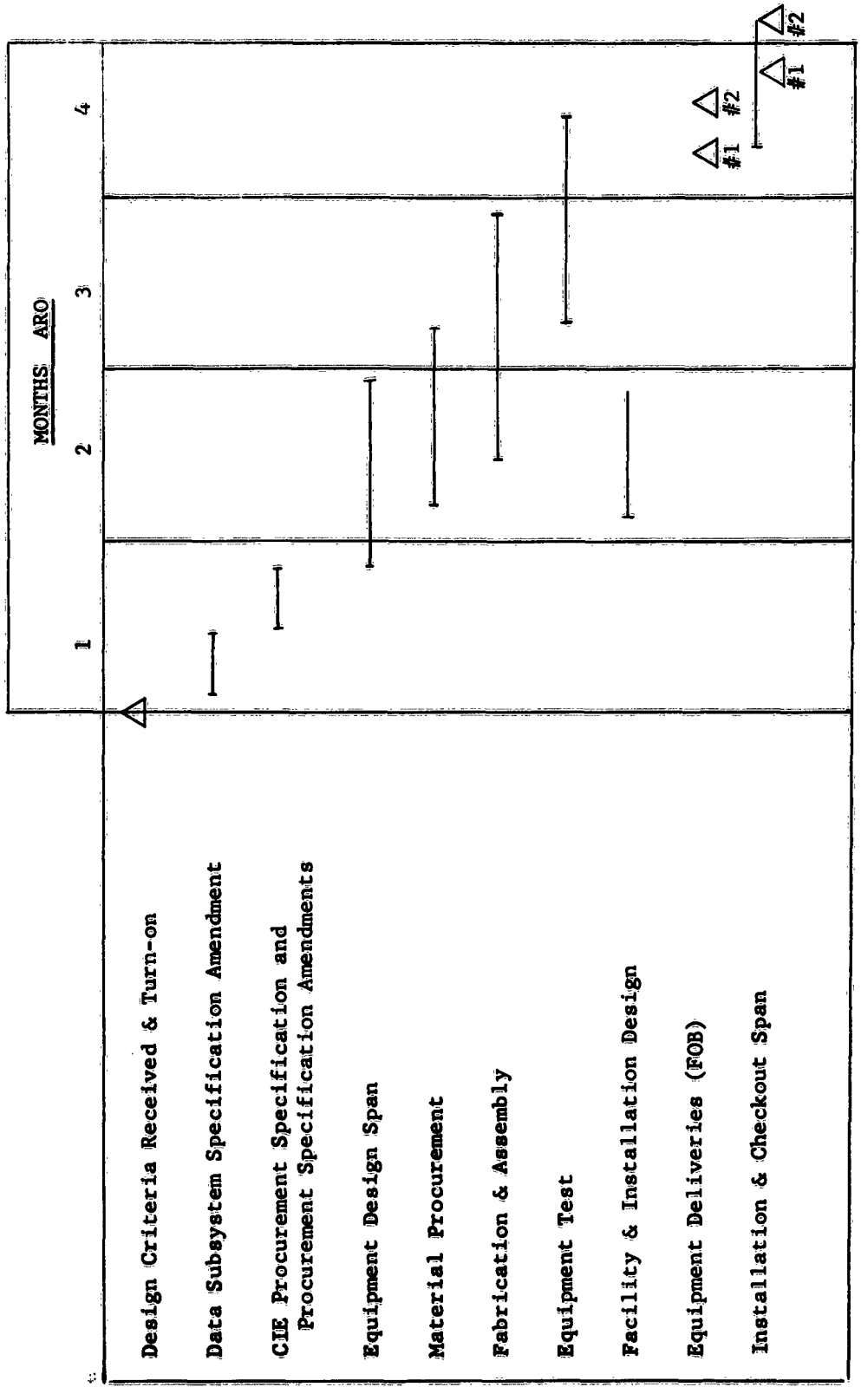


Fig. 4 Planning Schedule

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